HEALTH QUALITY COUNCIL

Saskatchewan Seniors Experiencing Hip Fracture: Characteristics and Health Outcomes

Summary Report
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Executive summary

Hip fracture is most common in seniors and results in adverse changes to functional ability, often leading to special-care home admission and even death. This study examined patient and health service characteristics and the health outcomes of Saskatchewan seniors who sustain a hip fracture. Differences in these characteristics and health outcomes for rural and urban residents were also explored because of known differences in service delivery in rural and urban settings.

In 2000, the Health Services Utilization and Research Commission (HSURC) convened a working group to guide the research. Administrative data on 2,677 Saskatchewan residents aged 65 and older and admitted to a Saskatchewan hospital for hip fracture between 1997 and 1999 were used to generate a general profile and explore the factors associated with health outcomes following hip fracture in seniors.

About 900 Saskatchewan seniors fractured a hip each year; 73 per cent were women. Twenty-two per cent of patients who were not residents of special care prior to hospitalization for hip fracture became permanent residents within one year of discharge from hospital; 69 per cent were admitted within three months of leaving hospital. A quarter of patients died within one year of fracturing a hip; 66 per cent died either during their acute care stay or within three months of hospital discharge.

Few patients needed to be transferred to another acute centre for treatment and those who required surgery usually had surgery within two days. This suggests that Saskatchewan seniors who suffered a hip fracture received timely surgical care.

After adjusting for age, gender, health status, and other factors, differences in health outcomes of rural and urban residents who fractured a hip were found. Rural residents were 20 per cent more likely to become permanent residents of a special-care home within one year while urban residents were 30 per cent more likely to die within one year. These differences in health outcomes were not explained by variations in the factors that we examined. They are likely due to factors not captured with administrative data.

Hip fracture patients who received organized care after they left hospital had better health outcomes. Patients who received post-fracture rehabilitation—either from a rehabilitation hospital, in a special-care home, or through home care—had half the risk of dying within one year as patients who did not receive these services. Community residents who were non-users of home care prior to admission to hospital for fracture and who did not use home care following hospital discharge were three times more likely to become permanent residents of special care and 2.5 times more likely to die within one year than those who received home care after hospitalization. The risk of death within one year was five times greater for non-users of osteoporosis drugs before and after hip fracture than for patients who began using osteoporosis drugs following fracture.

The findings illustrate that the first three months following fracture are the most crucial for subsequent admission to special care or death. Therefore, the HSURC working group recommends the development of an integrated clinical care pathway for the first three months

following acute care discharge for hip fracture. To ensure that an integrated pathway can be effectively implemented, the development of strategies to alleviate the current and projected care provider shortages is also recommended.

105-04402/

Introduction

Although hip fractures can occur at any age, they are most common in seniors (65 and older). Women are twice as likely as men to experience a hip fracture and incidence rates for both sexes increase exponentially with age, nearly doubling every five years.[1,2]

A recent review of injuries among Canadian seniors reported that for people over age 65, fractures of the lower limb were the leading cause of injury hospitalization for women and the second leading cause for men.[3] This review also indicated that Saskatchewan seniors had higher hospitalization rates for fracture of the lower limb than the Canadian average.

Mortality rates are greater for seniors who experience a hip fracture compared to those who do not with the highest risk of death occurring within the first six months.[4,5] Hip fractures also result in adverse changes to functional ability with less than 30 per cent of patients returning to their pre-fracture level of functioning.[6] They are a leading cause of loss of independence; often resulting in admission to a special-care home.

Hip fractures also place a considerable strain on the health care system. Of all types of fractures, hip fracture results in the greatest proportion of hospitalization and longest length of stay (LOS). A recent Ontario study reported that the average one-year cost of hip fracture for patients 50 years and older was $26,527. Patients returning to the community ($21,385) had a lower one-year cost compared to those transferred ($44,156) or readmitted ($33,729) to long-term care.[7]

A systematic review of the evidence on the effectiveness and cost-effectiveness of programs of care following the acute management of fractures in older people reviewed interventions designed to improve function or reduce hospital stay. Specific rehabilitation interventions by care giver groups and broader, organized programs of care were included in the review. The authors concluded that the types and outcomes of geriatric service interventions after hip fracture were strongly influenced by local conditions.[8]

The objectives of this study were to determine the characteristics and health outcomes of Saskatchewan seniors who sustain a hip fracture. Because of the known difference in service delivery in rural and urban settings, we also wanted to determine if there are rural-urban differences in these characteristics and outcomes.

Methods

In 2000, the Health Services Utilization and Research Commission (HSURC) convened a working group of opinion leaders with expertise in the management of osteoporosis and hip fractures to guide the research. The study addressed two research questions: what are the characteristics and health outcomes of Saskatchewan seniors with hip fracture, and are there differences in these characteristics and health outcomes between those residing in urban (population 10,000 or more) versus rural (population less than 10,000) areas.

We did a population-based, retrospective, longitudinal study linking Saskatchewan Health administrative data for 1995-2000. A pseudo-patient identification number generated by

Saskatchewan Health linked seven data files: population registry, hospital separation, outpatient prescription drug, physician services, special-care home (along with special-care home availability), home care, and the cancer registry. The Saskatchewan Health Data Access Review Committee gave ethics approval.

Our study population included all patients admitted to a Saskatchewan hospital between 1997 and 1999 with a hospital discharge diagnosis of hip fracture (ICD-9 code of 820.0 to 820.9) and the following additional criteria:

- Were 65 years of age or older at the time of admission,
- Were residents of Saskatchewan at the time of admission,
- Had no accident code other than for accidental falls, late effects of fall, or misadventure during care,
- Had at least two years of Saskatchewan Health coverage prior to admission, and
- Had not had a hospitalization for a hip fracture in the year prior to the index admission.

We used descriptive statistics to generate a general profile of the characteristics and health outcomes (mortality, special-care home admission, and complication requiring hospitalization). Along with demographic characteristics (age, sex, place of residence), we examined:

- Pre-fracture health status (co-morbidity, pre-fracture use of home care, pre-fracture use of osteoporosis drugs, pre-fracture special-care home residency),
- Patient acute-care clinical characteristics (type of fracture, surgical procedure, acute care length of stay),
- Health system characteristics (transfer for treatment, time to surgery, type of hospital, type of surgeon, availability of special-care home), and
- Post-fracture health services use (other acute/rehabilitation length of stay, post-fracture use of selected rehabilitation programs, post-fracture use of home care, post-fracture use of osteoporosis drugs).

(See Appendix A for description of ICD-9 codes and medication classes used for co-morbidity and Appendix B for list of ICD-9 and CPP codes used for complication requiring hospitalization.)

We used survival analysis to explore the factors associated with health outcomes following hip fracture. Survival analysis is concerned with studying the effect of selected factors (e.g., age, treatment) on the time to an event occurring (e.g., death). All the variables listed above were used, except for "other acute/rehabilitation length of stay" for three separate analyses to predict:

1. Any adverse outcome within one year (the first of: death, admission to special care, or complication requiring hospitalization).
2. Admission to special care within one year.
3. Death within one year.

Because of the variation in service delivery throughout the province, we also conducted a survey of physical and occupational therapy rehabilitation services for seniors following hip fracture. A two-page, self-administered survey was mailed to Directors of Community Services within the former 32 Saskatchewan health districts. Information was collected for the period 1997 to 1999 on how physical and occupational therapy rehabilitation services were delivered, how many

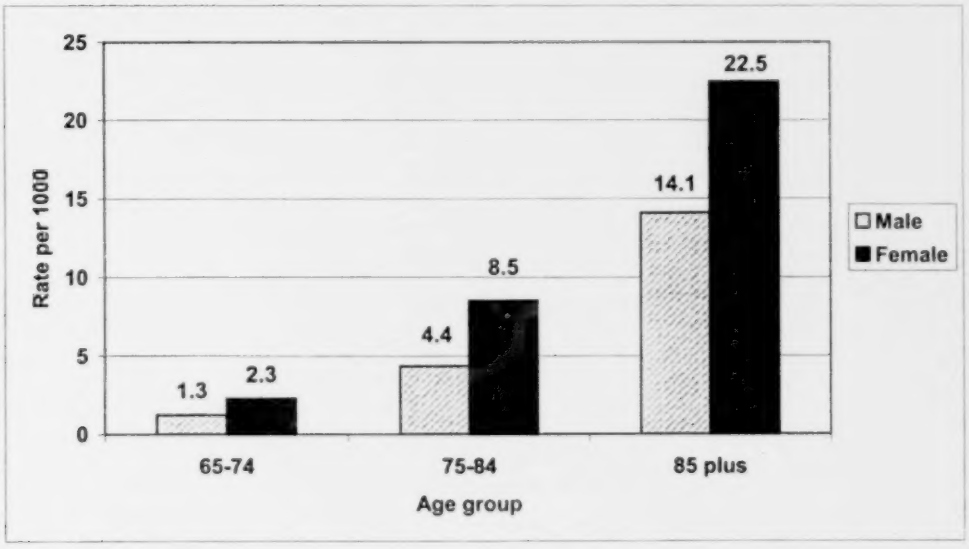
patients returning home received services, and the average start time after discharge home. Twenty-nine (91%) health districts responded.

Key findings

Demographic and pre-fracture health status characteristics

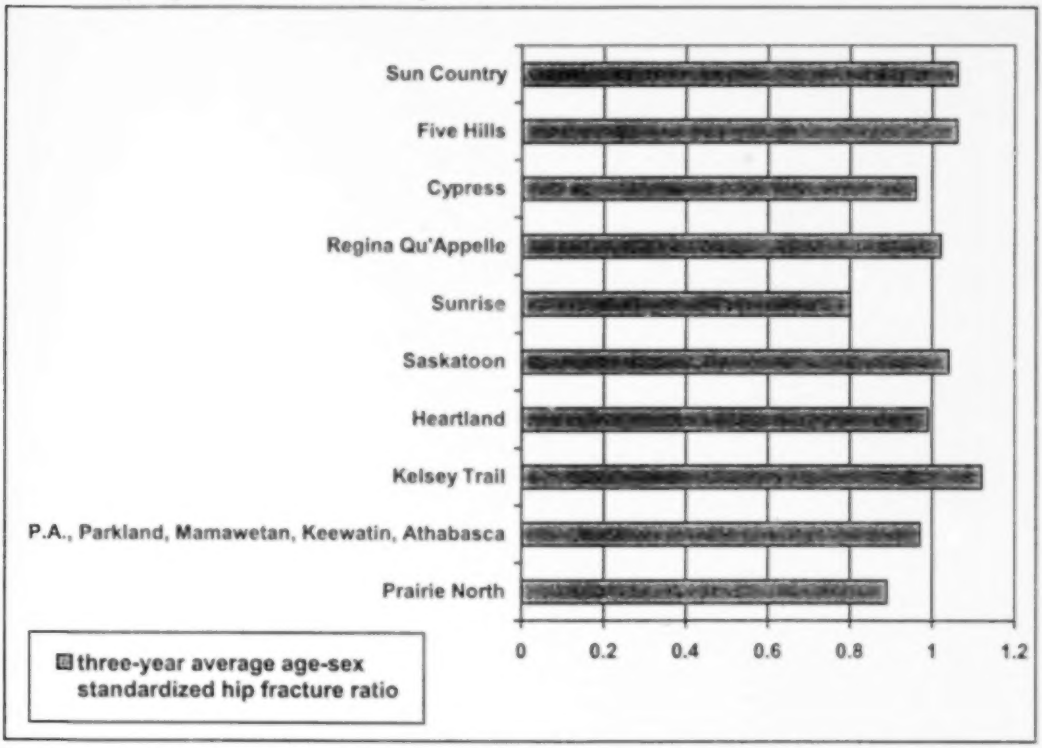
- Between 1997 and 1999, 2,677 Saskatchewan residents 65 and over sustained a hip fracture; most (73%) were women.
- The majority (85%) of hip fractures occurred at age 75 or older.
- The three-year average age-sex standardized hip fracture rate was 6.0 per 1000; women had a higher rate (7.8/1000) compared to men (3.6/1000). The hip fracture rate increased with age for both men and women (Figure 1).

Figure 1: Three-year average hip fracture rate (per 1000) for SK residents by age group and sex: 1997-1999



- Rural residents had a somewhat lower (5.7/1000) hip fracture rate than their urban counterparts (6.3/1000).
- There was little variation in regional health authority hip fracture rates when compared to the provincial rate (Figure 2).
- One-third (33%) were residents of a special-care home.
- Six per cent of patients used osteoporosis drugs (alendronate, etidronate disodium) within two years prior to hospitalization for hip fracture; most (79%) were women 75 and over.
- Four per cent of women used hormone replacement therapy within two years prior to hospitalization for hip fracture.
- More than one-third (38%) of non-special-care home residents used home care within one year prior to hospitalization for hip fracture; 12% of these people received nursing services.

Figure 2: Three-year average age-sex standardized hip fracture ratio for SK residents 65+ by regional health authority: 1997-1999



Note: The regional health authority ratio is compared to the provincial three-year average age-sex standardized hip fracture ratio, which equals one.

Patient acute care clinical characteristics

- Sixteen per cent of patients had no surgical procedure, 54 per cent had reduction of hip fracture, and 30 per cent had a total or partial hip replacement.
- The median acute care length of stay (LOS) was 10 days. Fifteen per cent of patients stayed longer than 21 days.
- The median acute care LOS for rural patients was eight days compared to 12 days for urban residents.

Health system characteristics

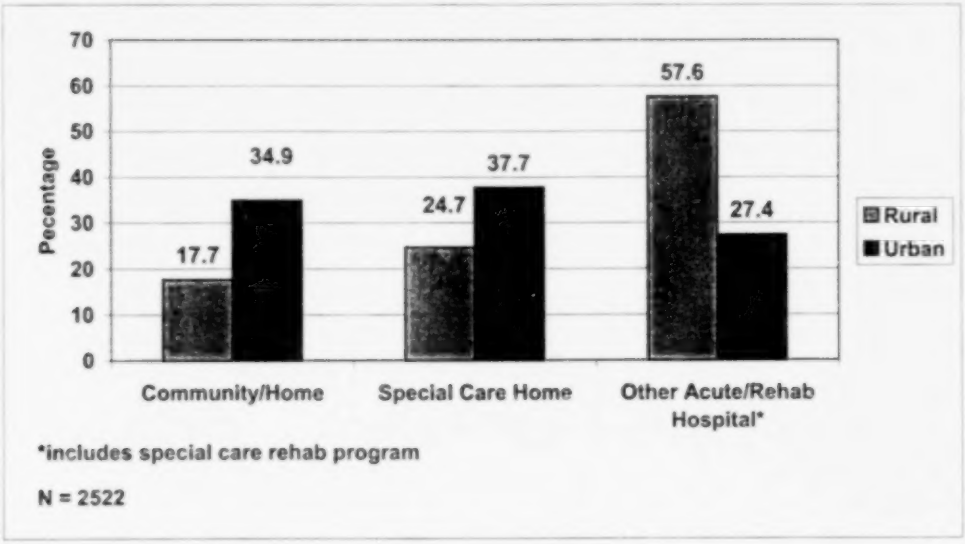
- Twelve per cent of patients were transferred to another acute centre for hip fracture treatment.
- Ninety per cent of patients were treated at a hospital where more than 100 hip fracture procedures were performed during the three-year study period.

- Of those patients who had a hip fracture surgical procedure, most (90%) had a procedure done within two days of admission.

Post-fracture use of health services

- Of patients discharged, forty-three per cent were discharged to another acute or rehabilitation hospital. Close to one-third (31%) were discharged to a special-care home and of these, about one-quarter (24%) were non-residents prior to hospitalization for hip fracture. Twenty-six per cent of patients were discharged to the community.
- Rural residents (58%) were more likely to be discharged to another acute or rehabilitation hospital compared to their urban (27%) counterparts (Figure 3).

Figure 3: Discharge setting following hospitalization for hip fracture by place of residence: 1997-1999



- The median total LOS (acute care and other acute/rehab hospital) for rural patients was 15 days compared to 16 days for their urban counterparts.
- The median cost of the total LOS (acute care and other acute/rehabilitation hospital) increased from $6,256 in 1997 and 1998 to $7,353 in 1999.
- Twenty-two per cent of patients had a post-discharge visit with a specialist specific for hip fracture within one year; of those, 31% had a visit within one month.
- About one-third (32%) of patients discharged to community/home had a family physician visit within one week of discharge. Rural residents (42%) were more likely than urban residents (26%) to have a family physician visit within one week.
- Of those patients who were discharged to community/home or other acute/rehabilitation hospital and who were non-users of home care prior to hospitalization, twenty-nine per cent received home care services within one year following discharge. Urban residents were more likely (35%) to receive home care services than rural residents (24%).

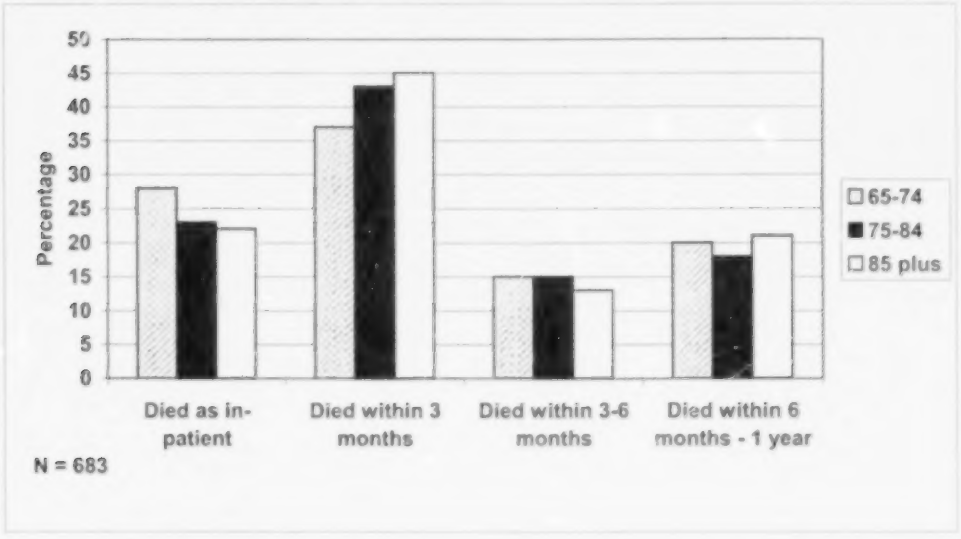
- Eight per cent of patients became first time users of osteoporosis drugs within one year of discharge.

Health outcomes

Mortality

- About one-quarter (26%) of patients died within one year of hospital admission for hip fracture. Men (36%) were more likely to die within one year than women (22%).
- One hundred fifty five (6%) patients died during their acute care stay; men had a higher (10%) in-hospital mortality rate than women (4%).
- The three-year average age-sex standardized one-year population mortality rate was 1.5 per 1000.
- The rural three-year average age-sex standardized one-year population mortality rate was lower (1.4/1000) than the urban (1.7/1000) rate.
- Of patients who died within one year of hospitalization for hip fracture, 66 per cent died either during their acute care stay or within three months following hospital discharge. There was no significant difference in the time to death for age group (Figure 4) or place of residence.

Figure 4: Time to death for patients who died within one year of hospitalization for hip fracture by age group: 1997-1999



Special-care home admission

- Almost one-quarter (22%) of non-special-care home residents prior to hospitalization were admitted to a special-care home as permanent residents within one year of discharge.
- Most (69%) were admitted within three months following hospital discharge. Urban residents were more likely (41%) to be admitted immediately after hospital discharge compared to rural (12%) residents.

Complication requiring hospitalization following hip fracture

- Ten per cent of patients experienced a complication during their acute care stay.
- Sixteen per cent of discharged patients had a subsequent hospitalization related to hip fracture or complication of hip fracture within one year.
- The most frequently occurring complications were congestive heart failure (30%), complication due to procedure or prosthesis (27%), and cerebral vascular disease (21%).

Predictors of health outcomes

The risk of experiencing any adverse event, including admission to special care and death, increased with age (Table 1). Men had almost twice the risk of dying within one year of hip fracture compared to women. There was no significant difference in risk for admission to special care between men and women. Residents of special-care homes prior to hospitalization for hip fracture had a higher risk of dying (40%) within one year than non-residents.

Patients undergoing a surgical procedure for hip fracture were less likely to experience any adverse event, or death compared to those who did not have a procedure. Patients whose acute care LOS was 16 or more days had four times the risk of admission to special care than patients with a shorter LOS.

After holding all other factors constant (age, sex, pre-fracture health status, clinical characteristics), we found that people living in urban centres had a 30 per cent increased risk of dying within one year of sustaining a hip fracture compared to their rural counterparts. However, rural residents had a higher risk (20%) of being admitted to special care than urban residents.

We explored system and treatment characteristics that might explain these differences. Patients whose time to surgery was three days or more had a 40 per cent increased risk of dying within one year than patients whose time to surgery was less than three days.

Patients who received selected post-acute hip fracture care had better health outcomes than those who did not. Patients who did not receive any type of selected rehabilitation (rehabilitation hospital, special-care home rehabilitation program, or home care physiotherapy) had twice the risk of dying within one year of hospitalization for hip fracture. Non-users of home care before or after hip fracture had three times the risk of being admitted to special care and 2.5 times the risk of dying within one year compared to patients who used home care following hospitalization. The risk of death within one year was five times greater for non-users of osteoporosis drugs before and after hip fracture than for patients who began using osteoporosis drugs following fracture.

These system and treatment characteristics, however, did not explain the urban/rural differences in health outcomes. Place of residence continued to partially explain the difference in risk of admission to special care or death within one year. This suggests that the differences for rural and urban residents are due to other factors we did not examine.

Post-hip fracture rehabilitation services

Our survey results revealed wide provincial variation in the type and amount of post-fracture physical and occupational therapy services for patients returning to the community between 1997 and 1999. Rehabilitation was mainly delivered through district community-based services or home care. A few districts contracted private providers and some patients chose to seek service from a therapist in private practice. In one district, neither physical or occupational therapy was available; physical therapy was not available in another district; and occupational therapy was not available in four other districts. Information from the SK Health database revealed that four districts organized the delivery of physiotherapy through home care throughout the study period.

A referral, either from a physician, or discharging hospital, or a self-referral, was necessary to access rehabilitation services. Generally most patients discharged home with a hip fracture received some form of physical therapy follow-up either as an outpatient or in their home. The average time to commencement of service was about seven to 14 days. Occupational therapy follow-up was less likely and limited to those referred because of specific difficulties.

In a number of districts, the delivery of physical and occupational therapy varied throughout the district and over the study period. Within the scope of their practice, occupational therapists supervised physical therapy programs when a physical therapist was not available and conversely a physical therapist supervised occupational therapy. Several districts identified recruiting and retaining therapists was a key concern. There appears to be a trend of more teaching of self-care with the expectation that patients will take more responsibility for their own exercise and follow-up.

Table 1: Hazard ratios for health outcomes within one year associated with characteristics among SK patients aged 65+ admitted to hospital for hip fracture from 1997-1999

		Any adverse event* (CI)	Admission to special care (CI)	Death (CI)
Age	65-74	1.00	1.00	1.00
	75-84	1.26 (1.05-1.52)	1.92 (1.28-2.89)	1.55 (1.15-2.09)
	85 plus	1.80 (1.50-2.16)	3.10 (2.09-4.61)	2.12 (1.58-2.86)
Sex	Female	1.00	--	1.00
	Male	1.35 (1.20-1.52)	--	1.75 (1.50-2.05)
Co-morbidity	Any diabetes drug in previous 2 years	1.32 (1.11-1.57)	1.64 (1.21-2.24)	1.33 (1.05-1.68)
	Any cancer diagnosis in previous quarter	1.29 (1.02-1.61)	--	1.94 (1.47-2.55)
	Any respiratory drug in previous 2 years	1.18 (1.02-1.37)	--	--
	Any cardiac drug in previous 2 years	1.15 (1.02-1.30)	--	1.25 (1.05-1.48)
	Any heart failure in previous 2 years	1.35 (1.20-1.52)	--	1.31 (1.11-1.56)
Special-care home pre-fracture		--	--	1.40 (1.18-1.66)
Procedure	No procedure	1.00	--	1.00
	Reduction of fracture	0.79 (0.68-0.92)	--	0.48 (0.39-0.58)
	Total or partial hip replacement	0.69 (0.58-0.82)	--	0.64 (0.50-0.80)
Length of acute care stay	0-6 days	1.00	1.00	1.00
	7-9 days	0.82 (0.70-0.96)	1.00 (0.69-1.47)	0.85 (0.69-1.04)
	10-15 days	0.3 (0.71-0.97)	1.43 (1.008-2.02)	0.67 (0.54-0.84)
	16 plus days	1.28 (1.10-1.48)	4.26 (3.11-5.85)	0.82 (0.66-1.03)
Residence	Rural	--	1.00	1.00
	Urban	--	0.80 (0.64-0.98)	1.25 (1.07-1.47)
Time to procedure	3 plus days	--	--	1.41 (1.09-1.83)
Rehab**		--	--	0.53 (0.40-0.70)
Home care post-fracture only		--	0.37 (0.27-0.51)	0.41 (0.30-0.56)
Osteoporosis drugs post-fracture only		--	--	0.20 (0.09-0.42)

*complication requiring hospitalization, admission to special care or death

**includes rehabilitation hospital, special care rehab program and home care physiotherapy

1.00 reference category

-- non-significant (confidence interval includes one)

Discussion

Our study findings should provide both encouragement and some cause for concern for both Saskatchewan residents who sustain a hip fracture and their health care providers.

Compared to earlier research, Saskatchewan witnessed an increase in the number of hip fractures occurring annually for people aged 65 and over but the incidence rate of hip fracture for this age group remained relatively stable. A Saskatchewan study examining hip fracture incidence rates between 1976-1985 reported an average of about 625 hip fractures per year compared to 890 per year between 1997-1999.[1] The average annual incidence rate between 1976-1985 was 5.5 per 1000 compared to 6.0 per 1000 in 1997-1999. Incidence rates for women remained twice that for men (1976-1985 7.0/1000 versus 3.5/1000; 1997-1999 7.8/1000 versus 3.6/1000). This trend of increasing numbers of hip fractures but stable incidence rates is explained by the growing number of people 65 and older and is similar to Canadian trends reported elsewhere.[7,8]

Only twelve per cent of patients were transferred to another centre for treatment, which suggests that most patients are transported directly to the centres that perform surgical procedures for hip fracture. Ninety per cent of patients who had surgery for hip fracture repair had the procedure within two days of admission. Patients who required medical stabilization or for whom surgery was not initially indicated but later required for pain management likely accounted for most of the surgical waits longer than two days. The complication rate following surgery was low with only ten per cent of patients experiencing an in-hospital complication following surgery.

The overall one-year mortality rate was 26 per cent. Men had a higher risk of dying than women. Older Saskatchewan residents experience similar hip fracture mortality rates to seniors in other jurisdictions.[2,9] About one-quarter of non-residents of special care prior to hip fracture were admitted as permanent residents within one year.

Rural/urban differences

A main objective of our study was to identify differences in characteristics and health outcomes between rural and urban residents. Rural and urban patients did not differ on demographic, pre-fracture health status, or clinical characteristics. Rural residents were more likely to be discharged to another acute hospital or rehabilitation than urban residents. Although more rural residents were transferred to another centre, the total LOS was similar for the two groups (15 and 16 days, respectively). Most acute care for hip fracture occurs in large centres; patients from smaller centres are often discharged to a hospital closer to their home to complete their recovery. More urban residents are discharged to special-care homes immediately following their acute care stay than rural residents.

Our analysis suggests some differences in health outcomes between rural and urban residents. Rural residents are more likely to be admitted to special care within one year even after controlling for the availability of special-care home beds. This may be explained by the fact that there are more personal care homes and other alternative housing in urban centres; these admissions are not captured in the special-care home data. Urban residents are more likely to die within one year. Sicker rural residents may be moving into urban centres to be closer to services and other factors such as social isolation and depression may account for the increased risk in

mortality. The differences in health outcomes are not explained by variations in the system or treatment characteristics we examined and are likely due to factors we are unable to identify with this study. However, these differences are also relatively small and may not be clinically significant.

Post-fracture follow-up

The most interesting finding of our study is the apparent reduction of risk for admission to special care and death for patients who received selected post-fracture follow-up. Patients who received rehabilitation from a rehabilitation hospital, special-care home rehabilitation program, or home care (19% of all patients discharged) had half the risk of dying within one year than non-recipients. Results from our rehabilitation services survey indicate that most patients received rehabilitation through hospital-based outpatient services. A limitation of our study is that data were not available on the type and amount of rehabilitation received from inpatient, hospital-based outpatient, or private services. The rehabilitation services for which we have data may be more targeted or timely for patients following hip fracture. Several studies have examined the effect of rehabilitation on health outcomes of older adults with hip fracture but these results are inconclusive.

Our study indicates that patients who receive home care post-fracture are less likely to be admitted to special care or die within one year than non-recipients. These findings are supported by other research. A Canadian study reported that patients who received home care services within 90 days had a lower risk of dying within one year.[9] An American study reported that patients 70 years and older discharged home had a significantly lower risk of nursing home admission within one year when they received home health services.[10]

People who have a hip fracture are at high risk for having a second hip fracture.[11] Recent studies report that the follow-up for the diagnosis and treatment of osteoporosis was adequate for less than 25 per cent of patients who sustained a fragility fracture.[11,12] Our study indicates that patients who received osteoporosis drugs post-fracture were significantly less likely to die within one year. The purpose of taking osteoporosis drugs post-fracture is to prevent subsequent hip fracture and the time needed to see an improvement in bone density is usually longer than one year. A limitation of our study is we had drug information for drugs listed on the provincial formulary and for patients who qualified for exceptional drug status. Data were not available for patients who paid privately for these medications. The reduced mortality risk may be the result of overall care provided by physicians more skilled in geriatrics and osteoporosis management or reflect income and social economic status.

Recommendations

HSURC's study working group developed the recommendations that follow. The board of the Health Quality Council will consider them in terms of its mandate and priorities.

1. *Development of an integrated clinical care pathway for the first three months following acute care discharge for hip fracture.*

The Health Quality Council should coordinate development of an integrated clinical care pathway focused on post-discharge follow-up care of hip fracture by the regional health authorities.

Research indicates that clinical care pathways for hip fracture can result in shorter LOS with no significant difference in complication and hospital readmission rates.[7,13] The first three months following fracture are the most critical for subsequent admission to special care or death. Preliminary results from unpublished Saskatchewan research suggests that patients need about three months to recover from the experience of a hip fracture before they are receptive to prevention strategies. An integrated clinical pathway would help insure that important transition points are identified (e.g., between acute care and rehabilitation programs/special care) as well as times for longer-term prevention follow-up that accommodate delayed patient readiness.

2. *Development of strategies to alleviate current and projected care provider shortages.*

The Health Quality Council should facilitate the development of strategies to alleviate current and projected care provider shortages by the regional health authorities and relevant professional associations.

Our findings, which are supported by previous research, indicate that the risk for admission to special care and death is reduced for seniors receiving selected post-hip fracture follow-up services. The effectiveness of an integrated pathway to ensure patients receive evidence-based care following discharge for hip fracture is dependent on the availability of qualified providers to implement the care pathway. In Saskatchewan the shortage of family physicians, nurses, and therapists is well documented. By addressing these shortages, all post-hip fracture patients will have access to home care services, rehabilitation services, and osteoporosis management.

3. *Further research to identify components of rehabilitation programs that reduce the risk of mortality following hip fracture.*

Researchers and practitioners in physiotherapy, in conjunction with the regional health authorities, should conduct further research to identify components of rehabilitation programs that result in improved health outcomes following hip fracture. Mobility may be a key factor in reducing mortality risk and the type and timing of rehabilitation may be important in achieving optimal mobility.

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Disclaimer

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Appendix A: ICD-9 codes and medication class used for co-morbidity

ICD-9 Code	Description
045	Acute poliomyelitis
340	Multiple sclerosis
797	Senility without mention of psychosis
805-809	Fracture of neck and trunk
430-434, 436	Cerebral vascular disease
290-294	Dementia
415-429	Heart failure
140-208	Cancer

Chronic Disease	Medication or Medication Class
Parkinson's disease	Autononics L-Dopa, Selegiline
Cardiac disease	Beta-adrenergic blockers, Calcium channel blockers, Disopyramide, Vasodilator nitrates, Digitalis glycosides Diuretics, loop, Procainamide, Quinidine, Class 1 A antiarrhythmics, Class 1 C antiarrhythmics Class 1 I antiarrhythmics
Diabetes	Insulins, Sulfonylyreas
Respiratory	Beta agonist bronchodilators, Xanthines, Cromolyn Inhaled corticosteroids

Appendix B: ICD-9 and CPP codes used for complication requiring hospitalization

ICD-9 Code	Description
263.0, 263.1, 263.8, 263.9	Malnutrition
293.9	Unspecified transient organic mental disorder
410	Acute MI
428.0	Congestive heart failure
430-438	Cerebrovascular disease
415.1	Pulmonary embolism and infarction
453.8	Other venous embolism and thrombosis
707.0	Decubitus ulcer
719.45	Pain in joint in pelvic region and thigh
728.2	Muscular wasting and disuse atrophy
730.00, 730.05, 730.08, 730.09	Osteomyelitis of hip
835.0-3	Dislocation of hip
996.4	Mechanical complication of internal orthopaedic device
996.66	Infection & inflammatory reaction due to internal joint prosthesis
996.77	Other complication due to internal joint prosthesis
997.0-5	Complications of a medical or operative procedure affecting specified parts of the body
998.5, 998.6	Post-operative infections
998.0-4, 998.7	Other complication of a medical or operative procedure
999.0-9	Complications of medical care not classified elsewhere
E870-876	Misadventures to patients during surgical and medical care
E878-879	Surgical and medical procedures as cause of abnormal reaction

CPP Code	Description
92.04	Arthotomy for removal of prosthesis (hip)
92.14	Other arthrotomy (hip)
93.51	Revision of total hip replacement
93.59	Revision of total hip replacement
93.61-4, 93.64	Other arthroplasty of hip